A Rational Explanation of Hidden Price

Samir Mamadehussene (UT Dallas)
Jingbo Wang (CUHK)
Yunfei (Jesse) Yao (CUHK)

An example of hidden price

StubHub:

1. Towards the start of the user's journey on stubhub.com, they are shown a price.

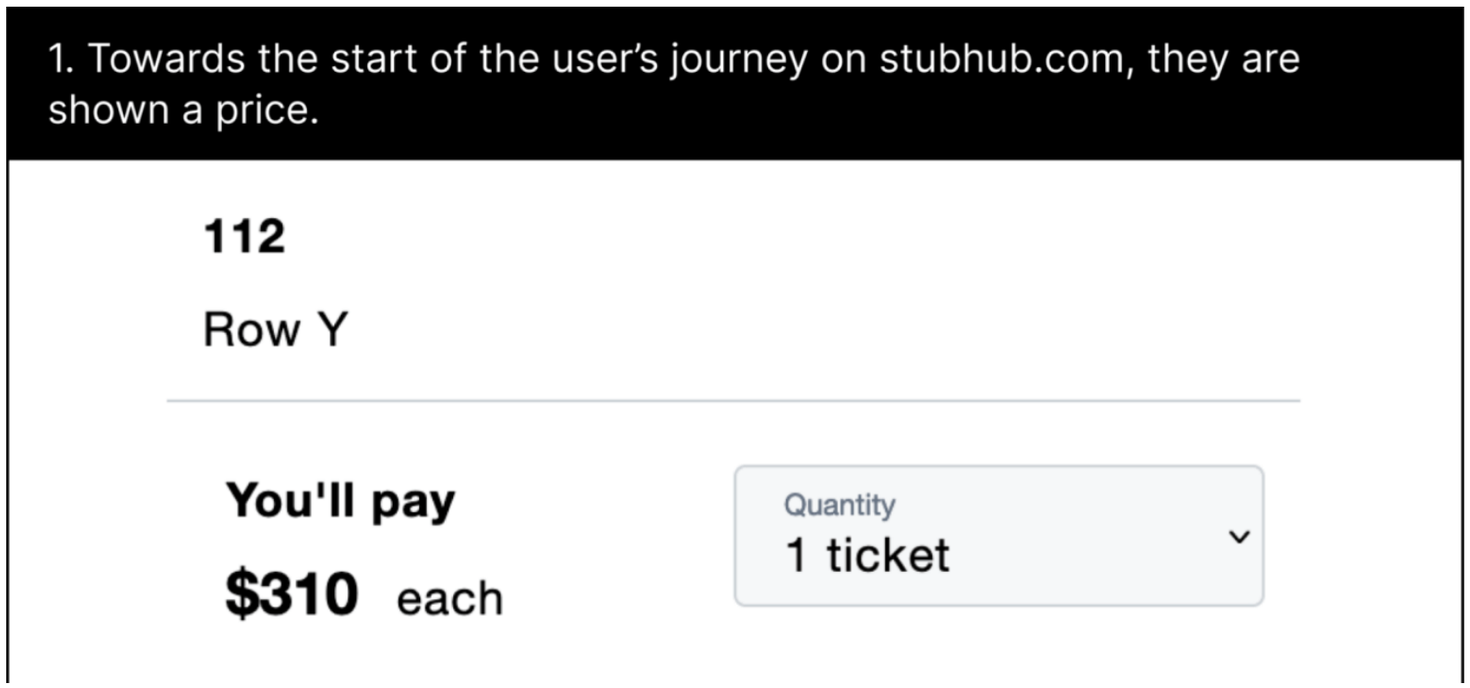

Figure source: https://www.deceptive.design/types/hidden-costs

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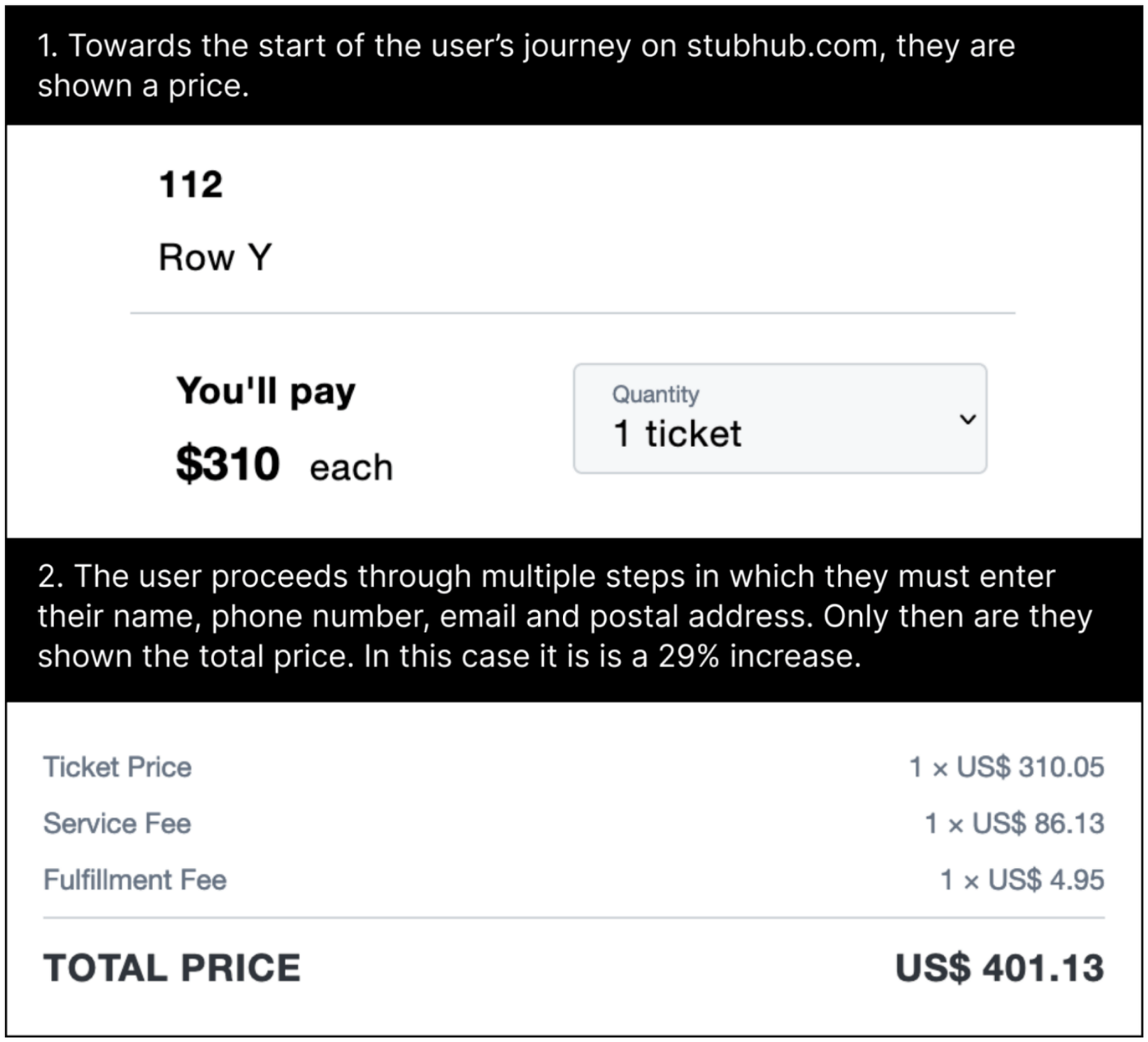

2. The user proceeds through multiple steps in which they must enter their name, phone number, email and postal address. Only then are they shown the total price. In this case it is is a 29% increase.

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Hidden price is impactful

- Blake et. al (2021): hidden price leads to
    - 21% more money spent
    - 14% higher purchase likelihood

Current explanation of hidden price

- Avoidable add-ons rather than unavoidable charges: Gabaix and Laibson (2006)
- Limited attention/Salience: Chetty et al. (2009), Golden and Homonoff (2013)
- Loss-aversion: Köszegi and Rabin (2006)

The above papers assume some kind of **behavioral bias**

- Unawareness of the fee softens price **competition**: Heidhues et al. (2021), Chen (2023)

A monopolist would never benefit from hidden prices

This paper

- A rational explanation without assuming any behavioral bias or competition
- Taking into account **consumer search**

Basic consumer search model (Branco et al. 2012)

- A firm offers a product with a marginal cost of m and price p
- A consumer decides whether to buy it
- The consumer can search for information before making a decision

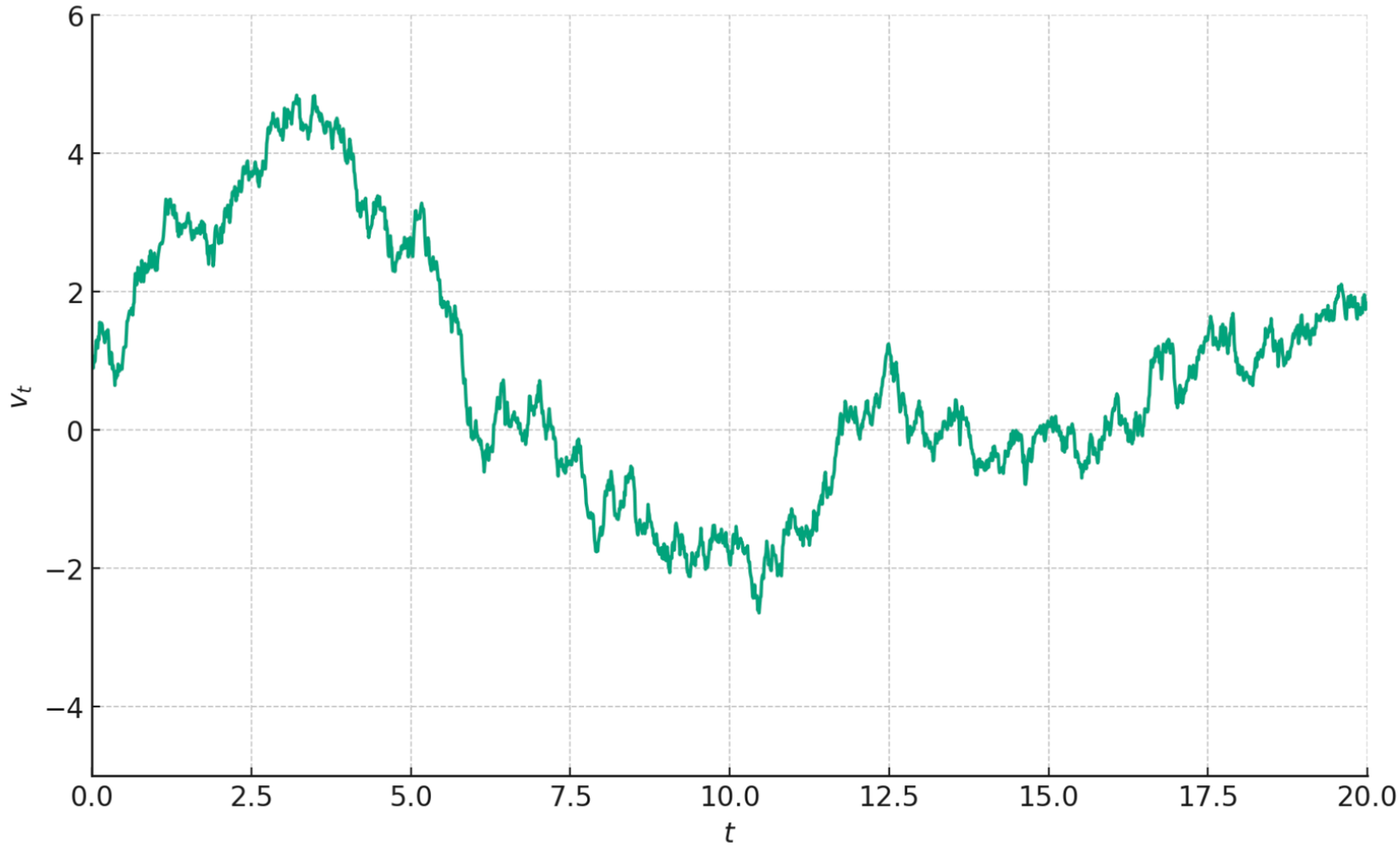
  initial valuation: v_0 (common knowledge)

  search cost: cdt per dt time

  consumer's valuation: $dv_t = \sigma dW_t$ (a Brownian motion)

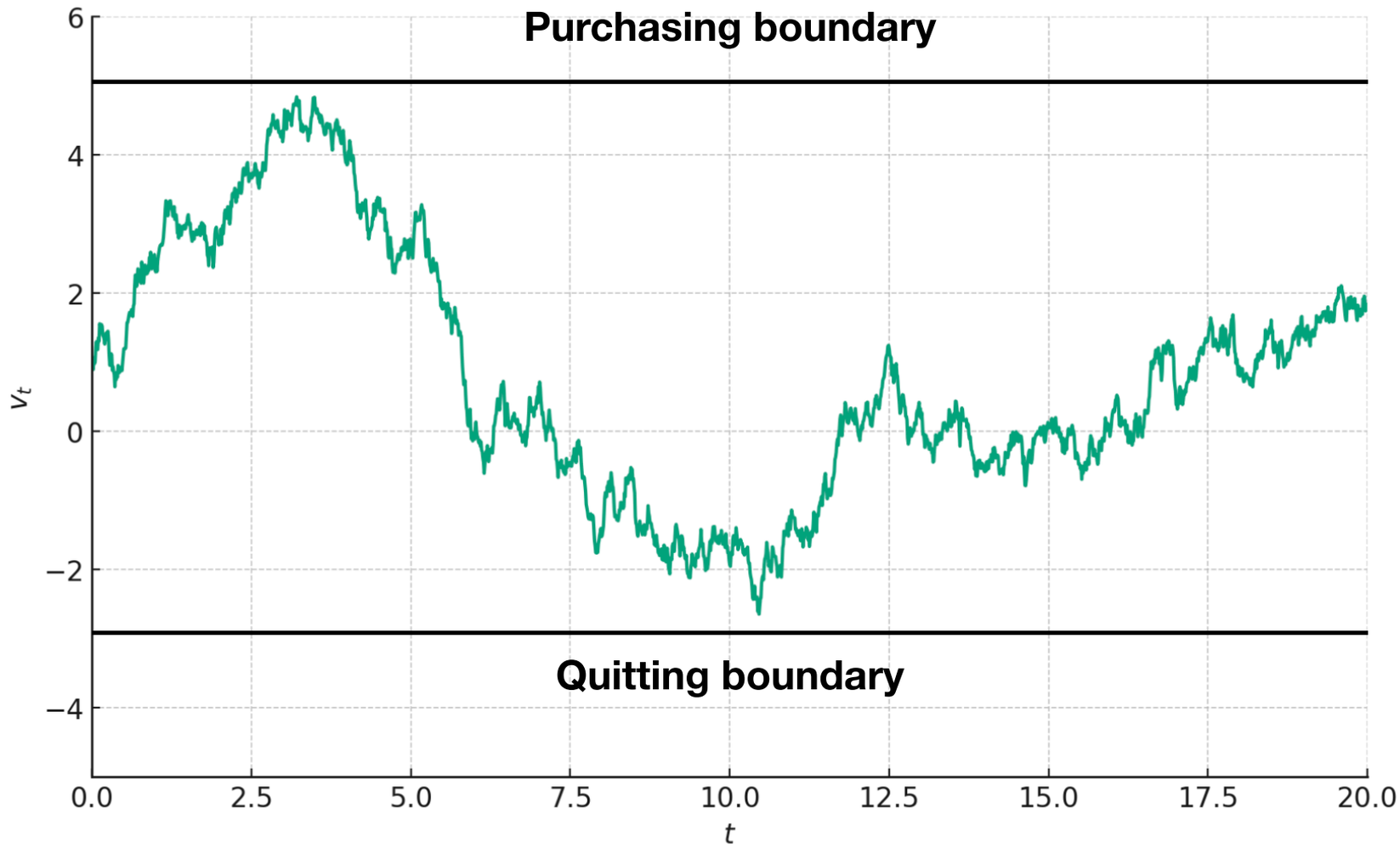
- No discounting

Sample path of the consumer's learning processes



$$v_0 = 1$$

Consumer's search strategy



$v_0 = 1, p = 1$

Consumer search can benefit the firm

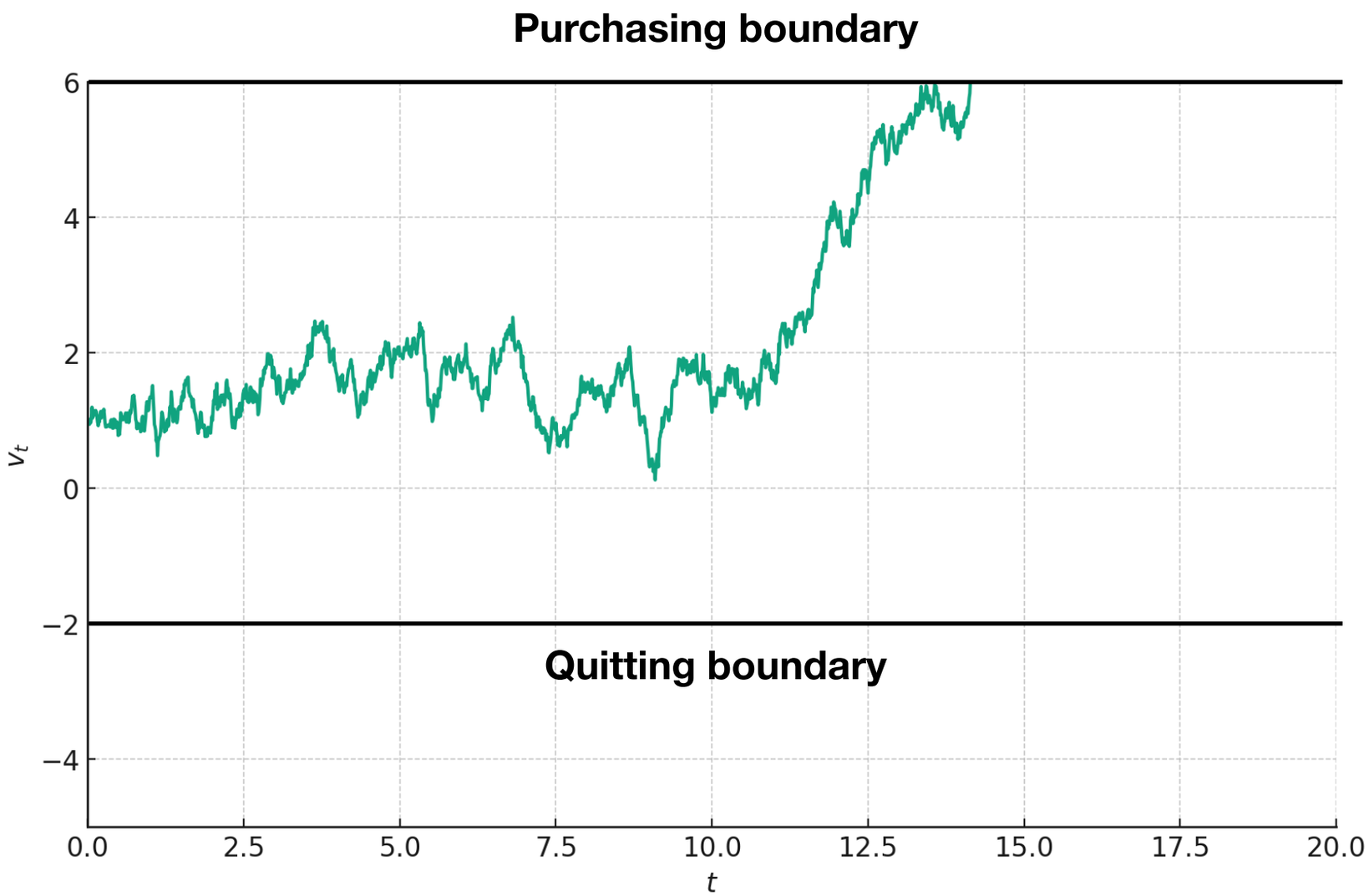
- When search is not feasible, the firm can charge at most v_0

The firm will not sell any product if the initial valuation is lower than the marginal cost, $v_0 < m$

- When search is feasible, the firm can charge a higher price

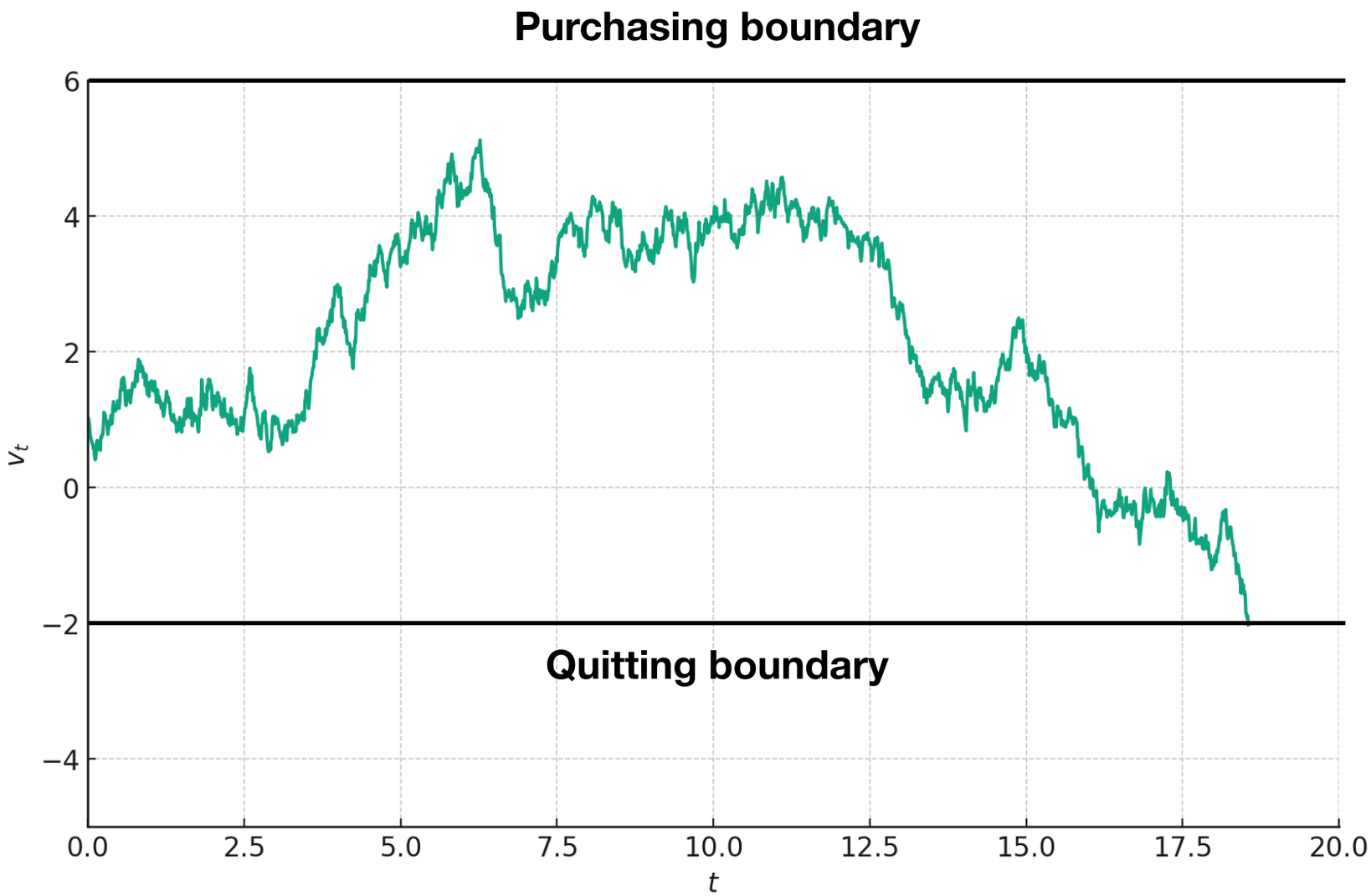
The firm can make positive profits even if $v_0 < m$

Purchase



$v_0 = 1,\ m = 1.5,\ p = 2$

No purchase



$v_0 = 1,\ m = 1.5,\ p = 2$

+ Hidden price

- The same setup as before, except that:
- When a consumer's valuation v_t reaches the purchasing threshold, she
  - decides to buy and go to the checkout page
  - will see an additional hidden price Δp
  - will not buy the product **without behavioral bias** (the hidden price raises the purchasing threshold)
  - faces an updated search problem
- The rational consumer **always chooses the best response** given available information.

Hidden price can benefit the firm

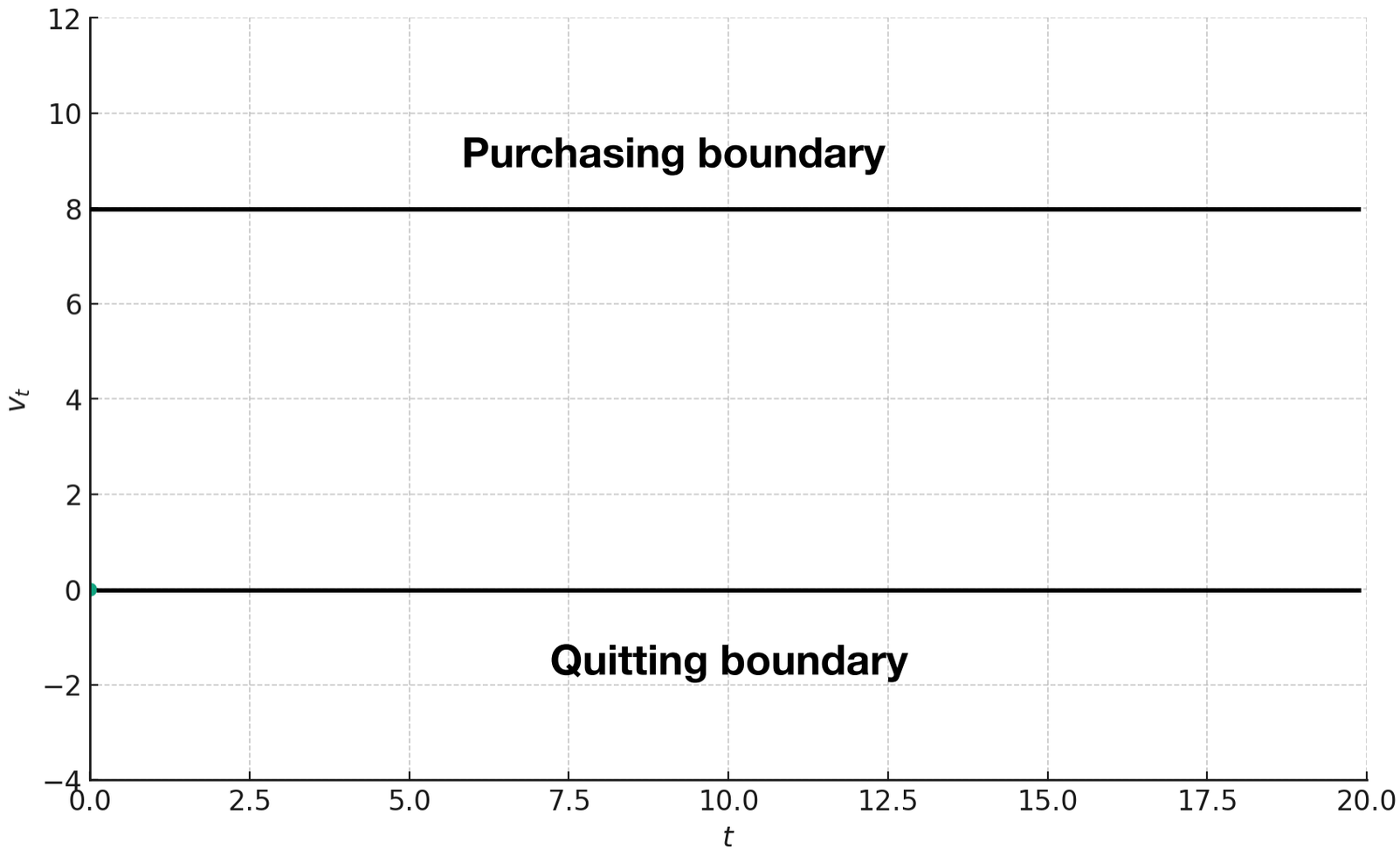
- When hidden price is not feasible, the firm cannot sell any product if $v_0 < -\sigma^2/4c + m$

- When hidden price is feasible, the firm can induce consumers to begin searching in cases where they would not have searched at all

The firm can make positive profits even if $v_0 < -\sigma^2/4c + m$

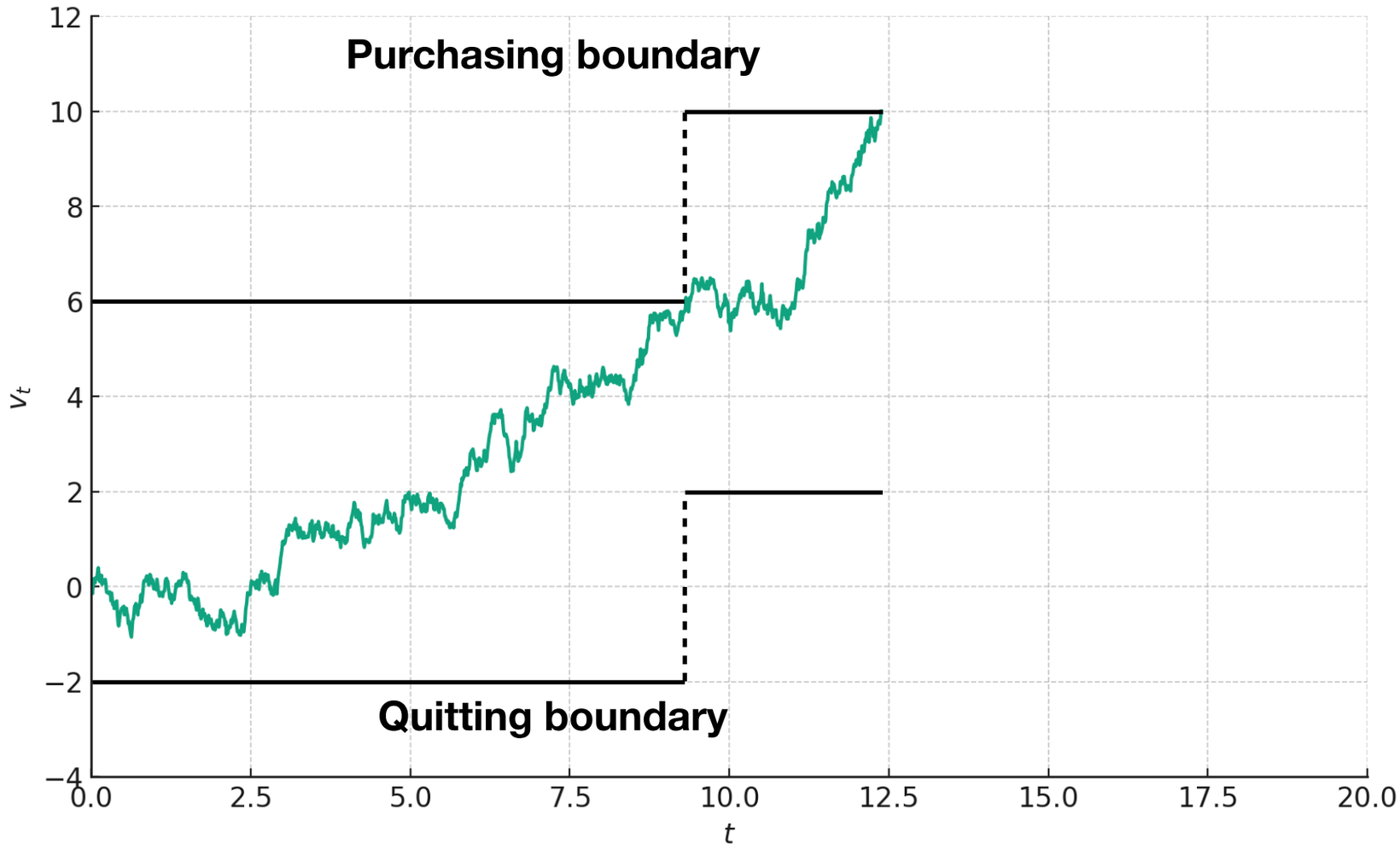
Parameter range: $\max\{-\sigma^2/4c, -3\sigma^2/4c + m\} < v_0 \leq -\sigma^2/4c + m$

Neither search nor purchase without a hidden price



$v_0 = 0,\ m = 4,\ p = 4$

Positive expected profit with hidden price



$v_0 = 0,\ m = 4,\ p_1 = 2,\ \Delta p = 4$

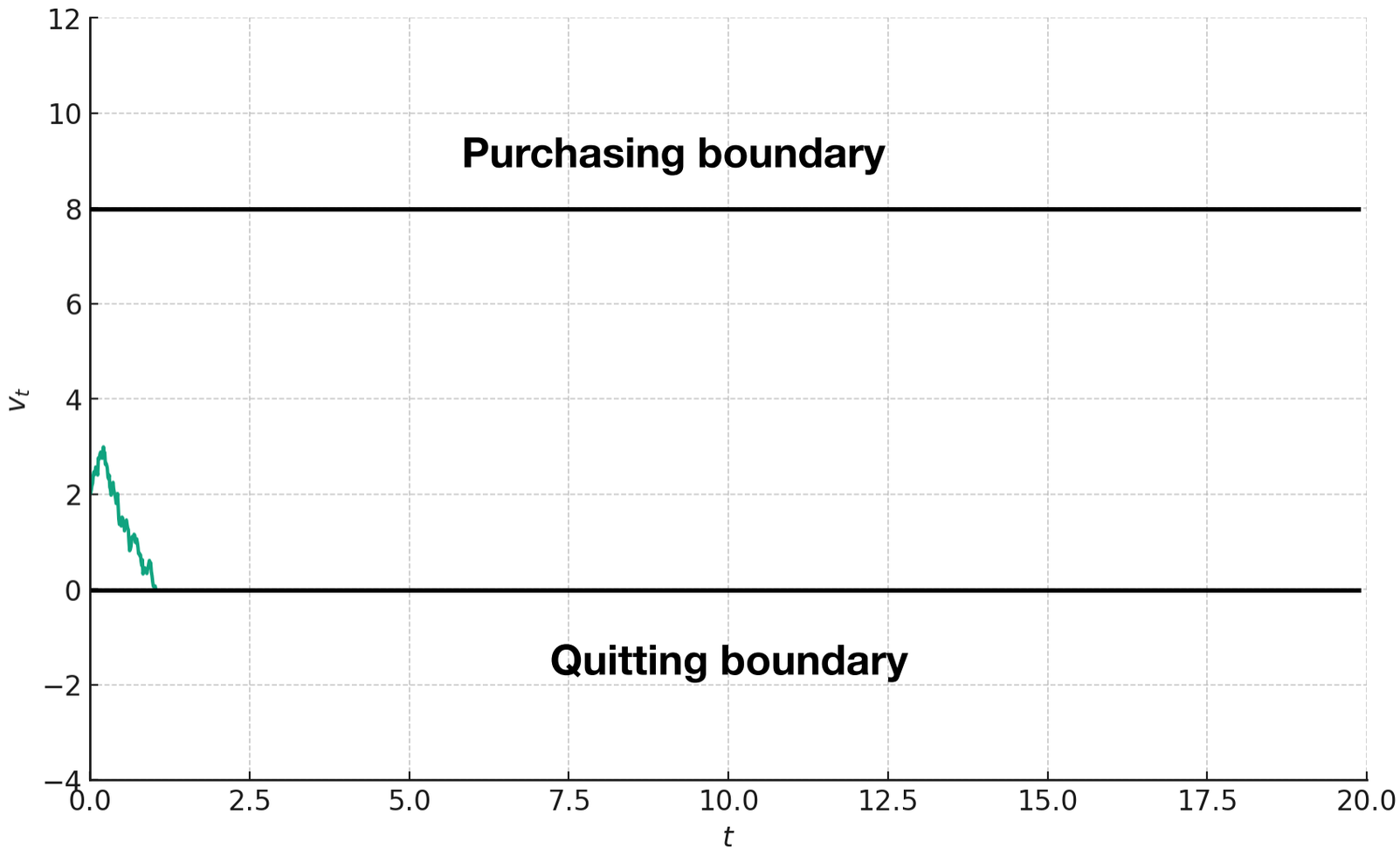
Hidden price can benefit the firm

- Even if the firm can earn a positive profit without hidden price when $v_0 > -\sigma^2/4c + m$, it can increase the profit by using hidden price

$\Rightarrow$ induce consumers to continue searching in cases where early signals are unfavorable (more persistent in search)

- Parameter range: $-\sigma^2/4c + m < v_0 < 3\sigma^2/4c + m$

Quick exit after searching without hidden price

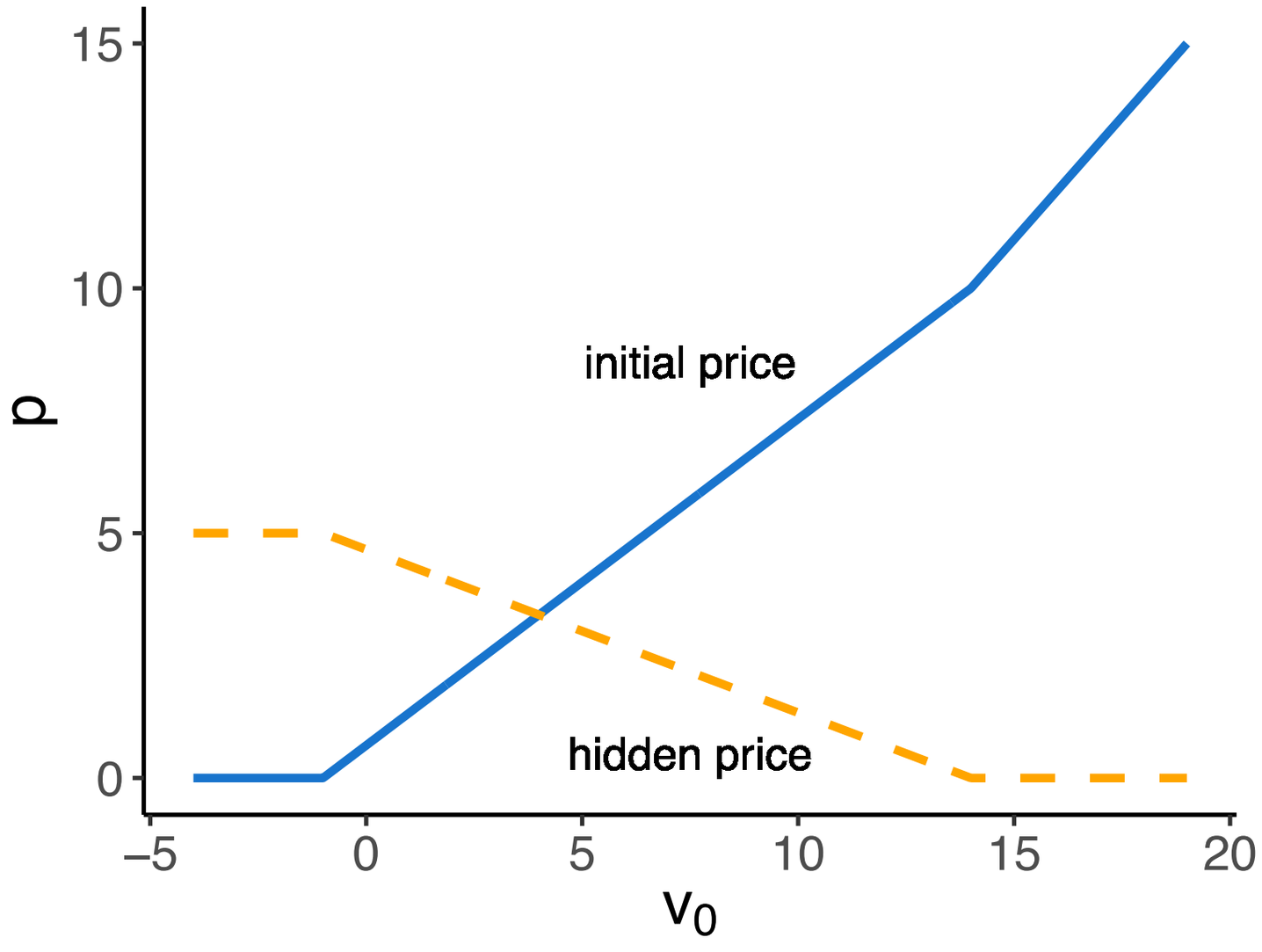


$v_0 = 2,\ m = 2,\ p = 4$

Purchase after searching with hidden price

$v_0 = 2,\ m = 2,\ p_1 = 2,\ \Delta p = 4$

Optimal Price with hidden price



$m = 2,\ \sigma = 0.4,\ c = 0.01$

Comparative statics of the optimal price with hidden price

- The hidden price Δp increases in the signal informativeness σ^2, the marginal cost m, and decreases in the search cost c, the initial valuation v_0

- The initial price p increases in v_0 and m (it does not depend on σ^2 and c)

- The total price $p + \Delta p$ increases in v_0, σ^2, m, and decreases in c

Expected search time under the optimal price with hidden price

- Relatively high initial valuation v_0

Expected search time in the first stage = in the second stage

The firm **perfectly smooths** consumers' search behavior

- Intuition: (consider a fixed total price)

Initial price too high ⇒ quitting boundary is close to v_0 ⇒ quick exit if the consumer gathers a few negative signals early on ❌

Initial price too low ⇒ purchasing boundary is close to v_0 ⇒ the consumer will go to the checkout stage with a high probability ⇒ a high hidden price ⇒ quitting boundary is close to her valuation ⇒ quick exit ❌

The optimal price balances consumers' search behavior in both stages

Expected search time under the optimal price with hidden price

- Relatively low initial valuation v_0

Search time in the first stage **<** search time in the second stage

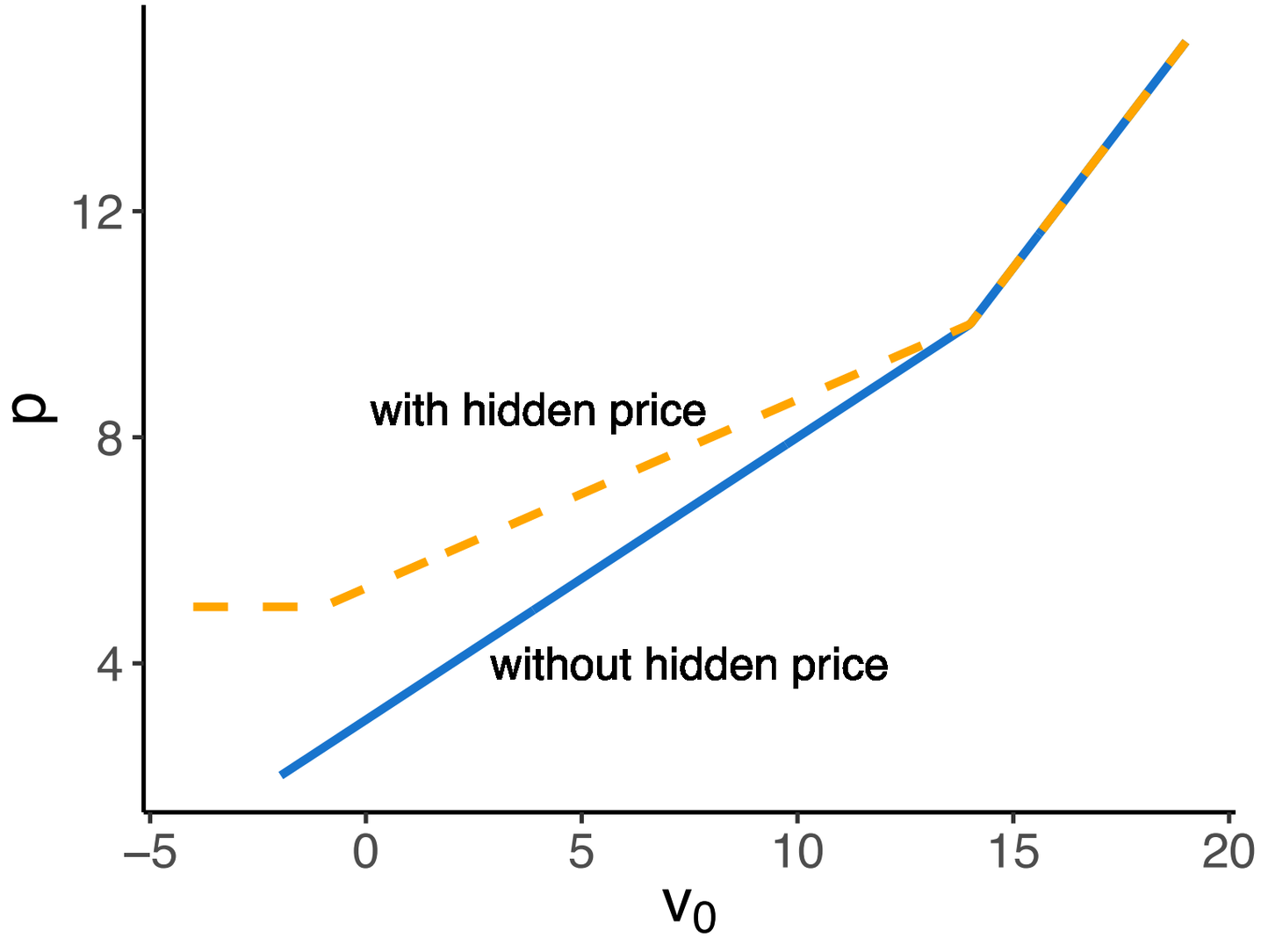
- Intuition:

Low v_0 ⇒ quitting boundary is close to v_0 even with a low initial price
⇒ quick exit if the consumer gathers a few negative signals

If a consumer reaches the checkout page ⇒ a much higher valuation
⇒ willing to keep searching even if she receives some negative signals

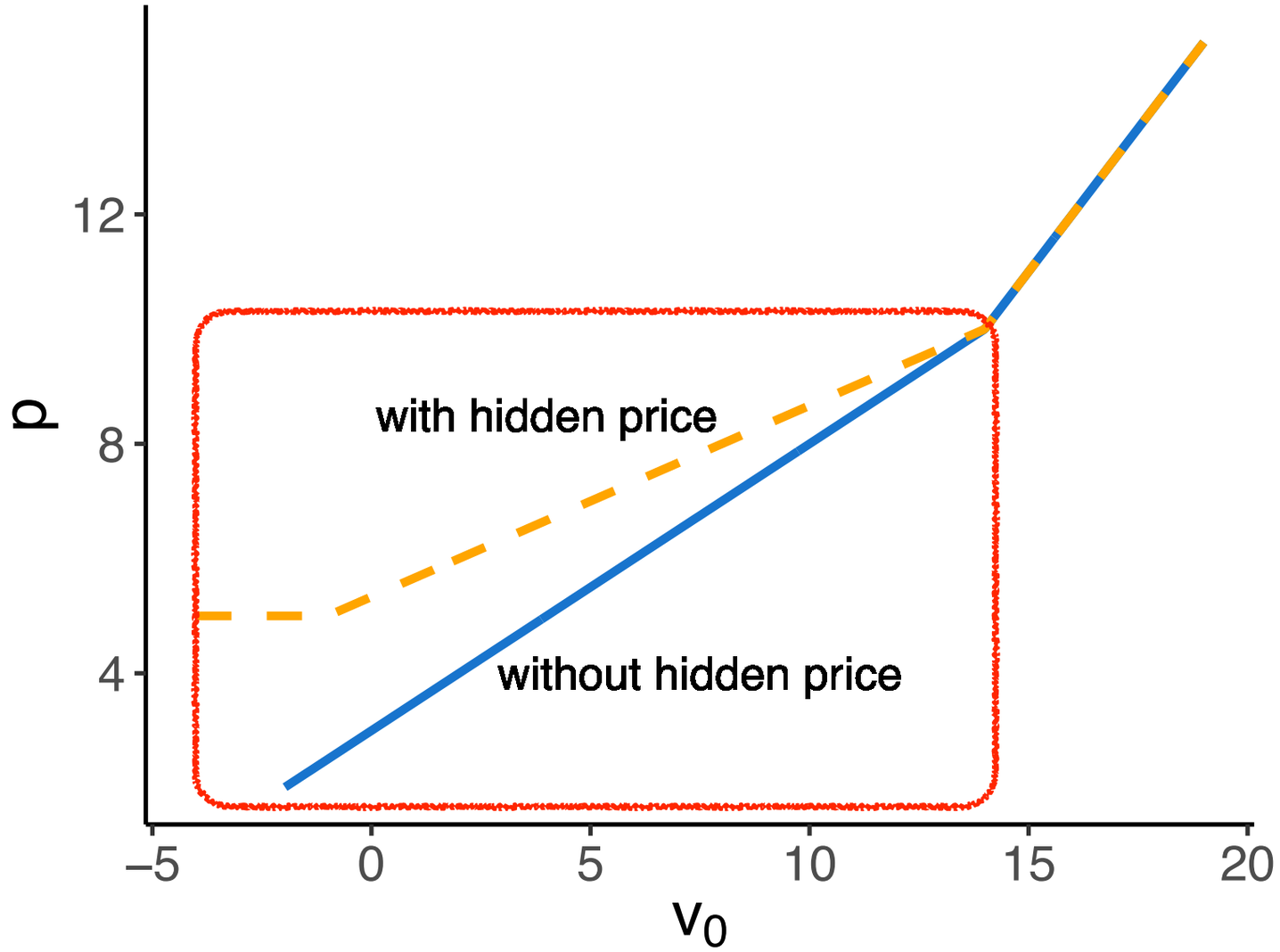
Impossible for the firm to perfectly smooth consumers' search behavior.

Optimal Price with and without hidden price



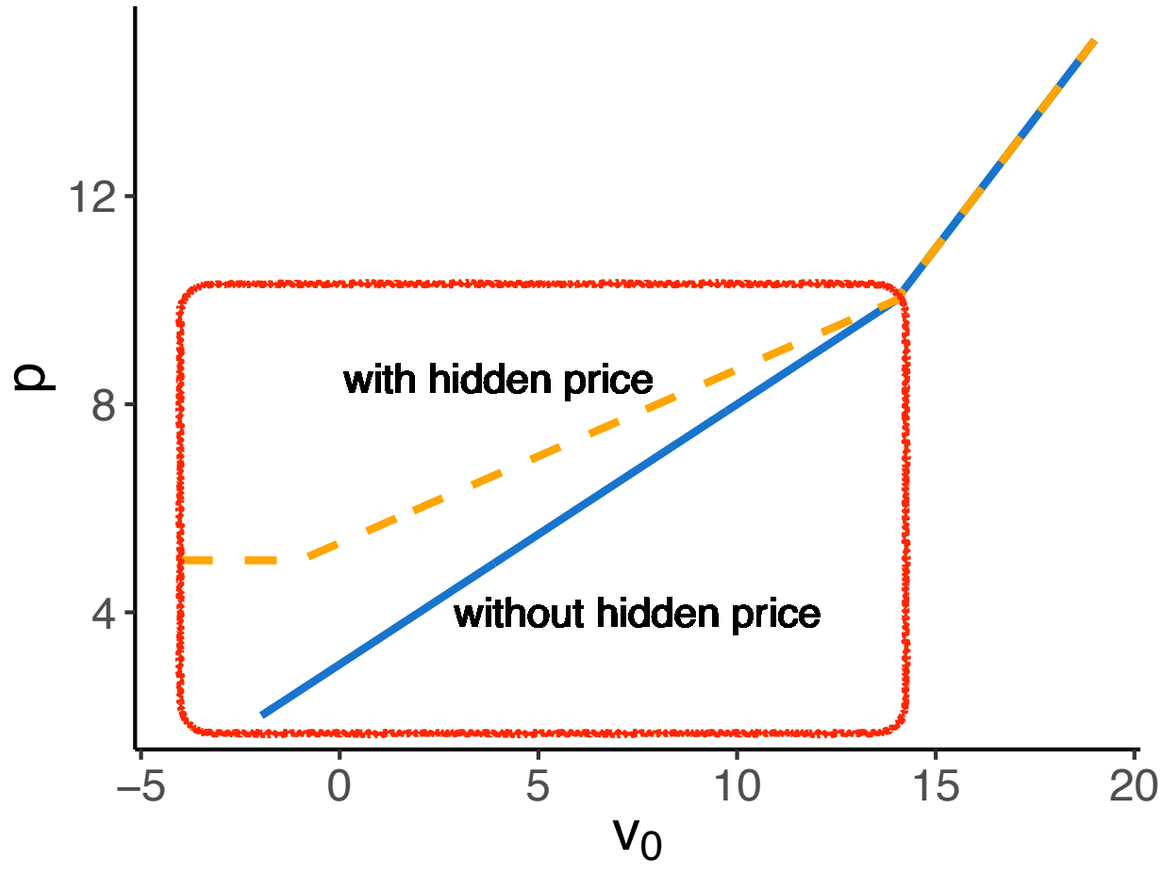
$m = 2,\ \sigma = 0.4,\ c = 0.01$

Strictly higher profit with a hidden price in the red area



$m = 2,\ \sigma = 0.4,\ c = 0.01$

Search behavior with and without hidden price



In the red area, the consumer's expected search time is strictly higher with a hidden price.

Heterogenous consumers

Heterogenous consumers

- Heterogenous learning speeds (this talk)

- Heterogenous Initial valuations

Heterogenous learning speeds

- Two groups of consumers with $\sigma \in \{\sigma^H, \sigma^L\}$, where $\sigma^H > \sigma^L$
- $Prob(\sigma = \sigma^H) = \rho_\sigma$
- Distribution of consumer types is common knowledge
- Realized type is each consumer's private information

Total price with hidden price may be lower than the price without hidden price

- Sufficient condition:

$\rho_\sigma < \widehat{\rho_\sigma},\ \sigma_H > \sqrt{3}\sigma_L,$
$\max\{-m/2, -\sigma_H^2/4c + m\} < v_0 < -3\sigma_L^2/4c + m,$
and $\sigma_L^2/2c < m$

- Basic mechanism:

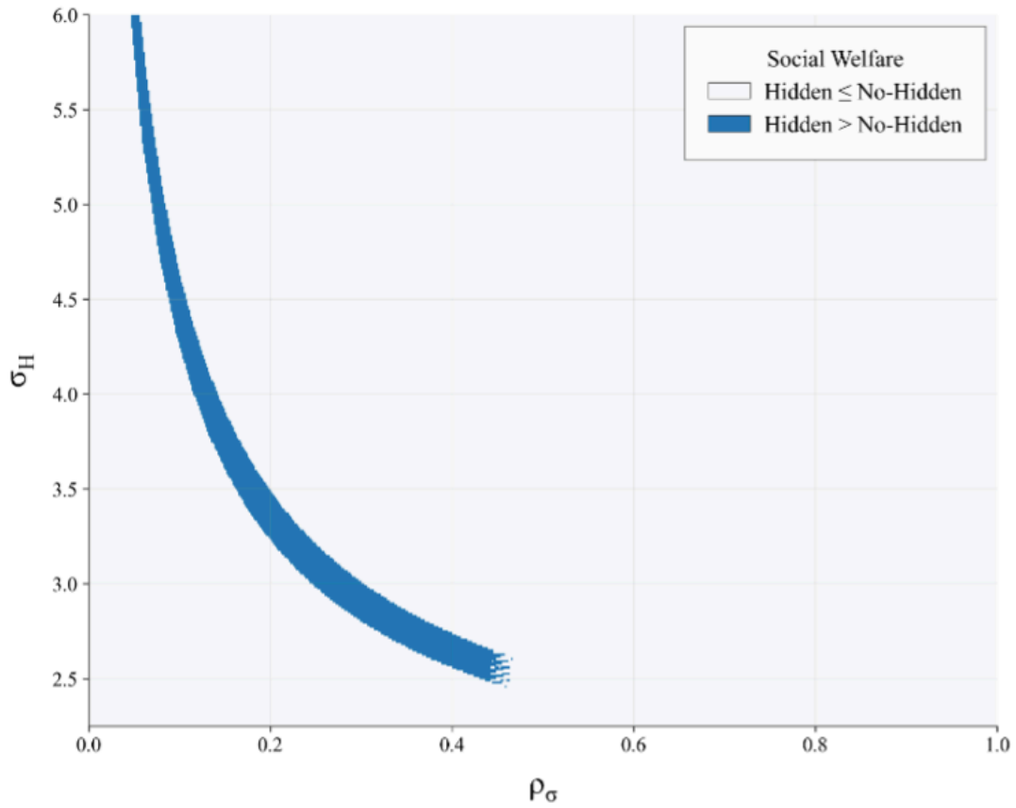
not profitable to sell to low-learning-speed consumers without hidden price

set the price optimal for high-learning-speed consumers (high price)

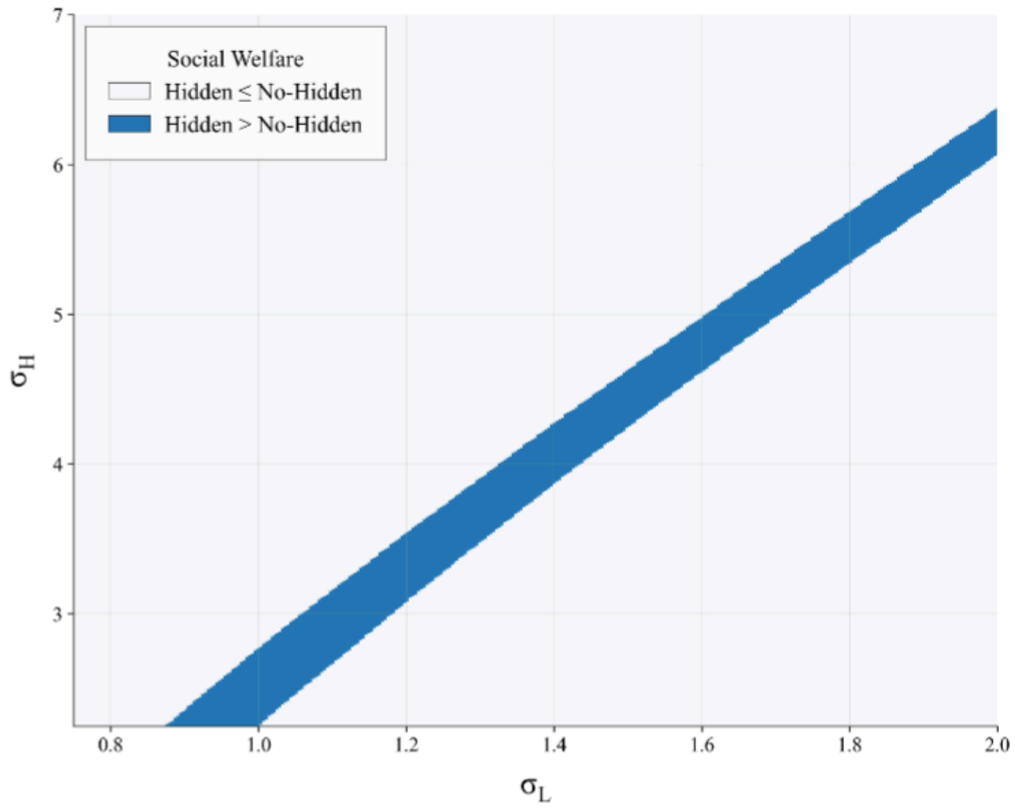
profitable to sell to both types of consumers with hidden price

reduce the price to expand the market (low price)

The use of hidden price can even increase social welfare!



(a)



(b)

Extension

Some consumers are aware of the hidden price

- ρ proportion of the consumers are unaware of the possibility of hidden prices

- Remaining $1-\rho$ proportion of the consumers are aware of it $\Rightarrow$ rationally anticipate the seller's pricing strategies in the second stage

- Proposition: For any $\rho > 0$, there exist parameters such that the firm's expected profit is strictly higher with a hidden price.

Thanks!